محاضرة رقم 2 الميكانيك الهندسي

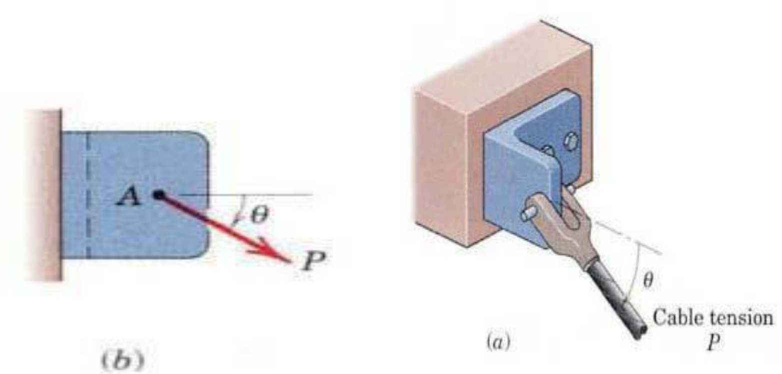
Force Systems

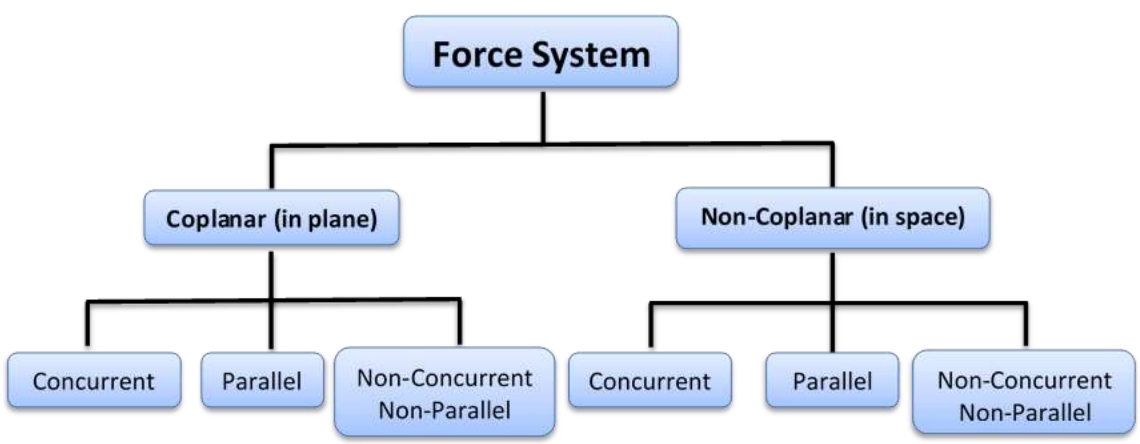
Before dealing with a group or *system* of forces, it is necessary to examine the properties of a single force in some detail. The action of the cable tension on the bracket in Fig. *1a* is represented in the side view, Fig. *1b,* by the force vector P of magnitude P. The effect of this action on the bracket depends on *P,* the angle *θ,* and the location of the point of application A

توضيح

أنظمة القوى

قبل الخوض في دراسة مجموعة أو نظام من القوى، من الضروري فحص خصائص قوة واحدة بتفصيلٍ ما. يُمثَّل تأثير شدّ الكابل على الدعامة في الشكل 1أ في المنظر الجانبي، الشكل 1ب، بواسطة متجه القوة P ذي المقدار P. ويعتمد تأثير هذا الفعل على الدعامة على P والزاوية θ، وموقع نقطة التأثير A.



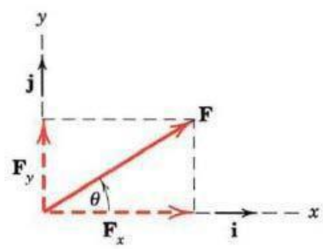


Coplanar= متحد المستوى

Concurrent= متزامن

TWO-DIMENSIONAL FORCE SYSTEMS
RECTANGULAR COMPONENTS

The most common two-dimensional resolution of a force vector is into rectangular components. It follows from the parallelogram rule that the vector F of Fig. may be written as

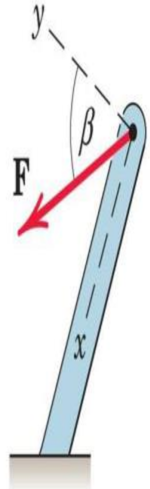


The scalar components can be positive or negative, depending on the quadrant into which F points.

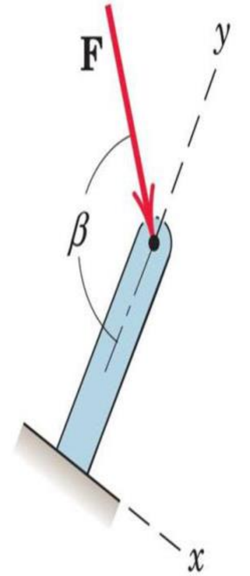
$$F_x = F\cos\theta \qquad F = \sqrt{{F_x}^2 + {F_y}^2}$$

$$F_y = F\sin\theta \qquad \theta = \tan^{-1}\frac{F_y}{F_x}$$

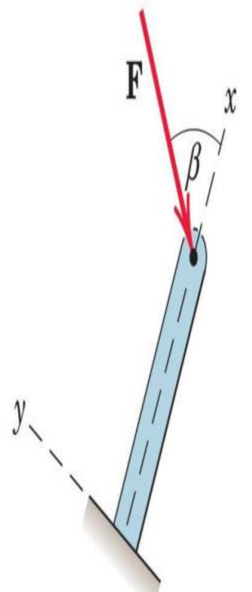
Determining the Components of a Force Dimensions are not always given in horizontal and vertical directions, angles need not be measured counterclockwise from the x-axis, and the origin of coordinates need not be on the line of action of a force



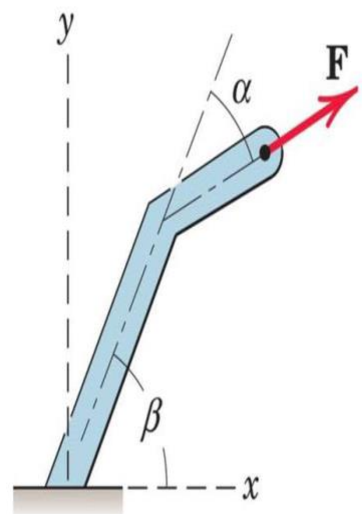
$$F_x = F \sin \beta$$
$$F_y = F \cos \beta$$



$$F_x = F \sin(\pi - \beta)$$
$$F_y = -F \cos(\pi - \beta)$$



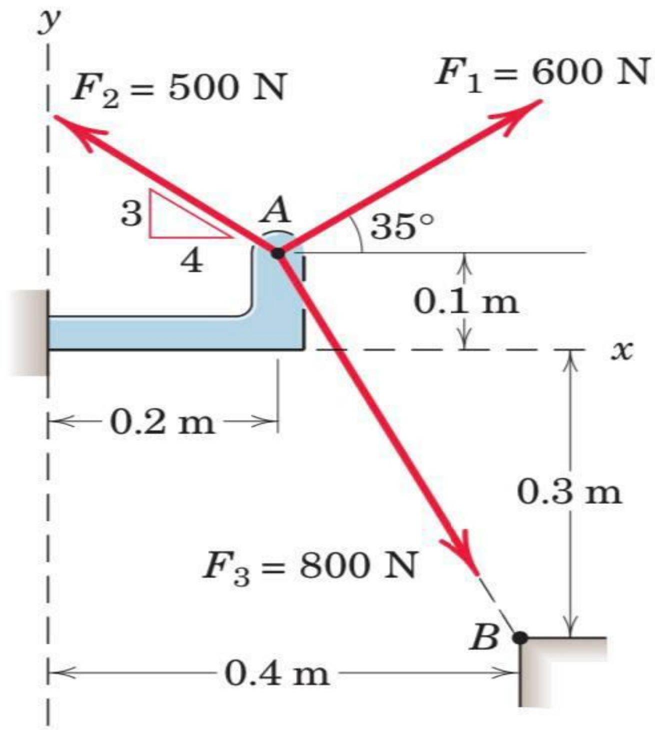
$$F_x = -F \cos \beta$$
$$F_y = -F \sin \beta$$

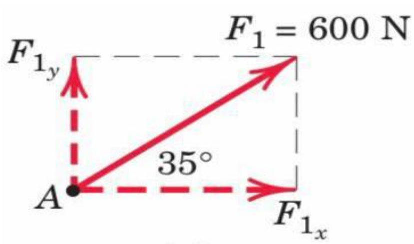


$$F_x = F \cos(\beta - \alpha)$$
$$F_y = F \sin(\beta - \alpha)$$

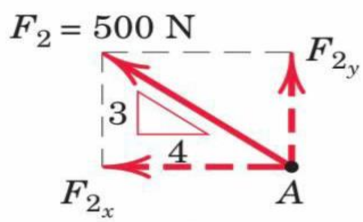
Problem 1

The forces F1, F2, and F3' all of which act on point *A* of the bracket, are specified in three different ways. Determine the *x* and *y* scalar components of each of the three forces.

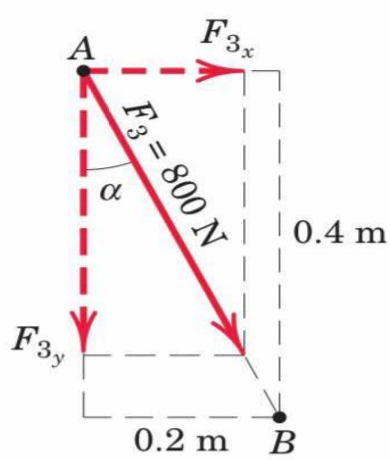




(*a*)



(*b*)



(*c*)

Solution:

The scalar components of F 1 ' from Fig. a, are

$$F_{1x} = 600 \cos 35° = 491\ N$$

$$F_{1y} = 600 \sin 35° = 344\ N$$

The scalar components of F2 from Fig. b, are

$$F_{2x} = -500(4/5) = -400\ N$$

$$F_{2y} = 500(3/5) = 300\ N$$

$$\alpha = \tan^{-1} [0.2/0.4]$$

$$=26.6°$$

Then

$$F_{3x} = F_3 \sin\alpha = 800 \sin 26.6° = 358\ N$$

$$F_{3y} = - F_3 \cos\alpha = - 800 \cos 26.6° = - 716\ N$$